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NOSC MODEL DLM-1 SYNCHRONOUS/ASYNCHRONOUS DATA-LINE MONITOR/ANA--ETC(U)

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Technical Report 194

NOSC MODEL DLM-1 SYNCHRONOUS/ ASYNCHRONOUS DATA-LINE MONITOR/ANALYZER

RL Mitchell, Jr

19 December 1977

Research and Development: January — August 1977

Approved for public release; distribution is unlimited

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A data-line monitor, under microprogram control, is described and its application in monitoring activities on serial data lines linking a computer with remote terminals is discussed. Synchronous protocols are accommodated by the monitor and additional protocols may be obtained by minimal software changes.

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OBJECTIVE

Develop a device for monitoring activity on serial data lines linking a computer with remote terminals which would be compatible with the numerous protocols now in use in the field.

RESULTS

The NOSC DLM-1 Synchronous/Asynchronous Data-Line Monitor/Analyzer was developed as a result of this effort. It has been demonstrated to operate with existing protocols and character sets and, because it is under microprogram control, will accommodate new protocols and character sets as they come into being.

RECOMMENDATION

Use of the Monitor/Analyzer is recommended in existing systems where data-line monitoring is required and in future systems in order to reduce cost and complexity of such installations.

CONTENTS

ILLUSTRATIONS

INTRODUCTION

Any facility which supports a computer communications system requires some means of monitoring the activity on the serial data lines linking the computer to its various terminals. Numerous different protocols and character sets may be in common use at any given facility thereby complicating the problem of accurately monitoring all of them.

In many cases in the past, the only solution has been to purchase several different monitoring devices from various manufacturers in an attempt to cover all protocol and character set bases. This solution has been not only costly but time consuming and has caused problems with where to store the numerous monitoring devices, how to connect and switch them within the communications system, and how to keep maintenance personnel efficient in the use of this vast array of diversified devices. In an effort to eliminate these shortcomings, an experimental device was designed and constructed to contain a number of features deemed to be necessary and desirable but heretofore unavailable in one unit.

This new device (figure 1) was designated the NOSC DLM-1 Synchronous/Asynchronous Data-Line Monitor/Analyzer. It has proven itself to be a great asset to a facility which is currently encountering the problems just cited but also to the facility which is in the process of setting up its communications system and wants to avoid such difficulties. This goal is achieved by integrating a multiprotocol, multicharacter set monitoring/analyzing capability into one easy-to-use package which is readily adaptable to new protocols and character sets which might arise in the future. This adaptability comes about because the monitor is under microprogram control and, thus, desired changes are accomplished by making slight changes in the software. The synchronous protocols for which the DLM-1 Monitor/Analyzer is set up include Univac NTR, REM-1, and Microdata protocols, IBM non-transparent Bi-Sync protocol, and Interface Message Processor Very-Distant Host transparent protocol.

CONTROLS

The various monitor functions and options are available through a minimum of front-panel switch selections and monitored data can be analyzed in just about any format commonly desired. The minimum equipment, external to the monitor, is a standard CRT video display capable of accepting composite video input (figure 2, left). To make use of the screen-dump feature of the monitor, a separate asynchronous terminal is required to receive the screen data when it is dumped in its hexadecimal, octal, or binary form (figure 2, right). The dump may be a hard-copy type if a permanent record is required. In the synchronous mode, the monitor is capable of interpreting eight different code sets with five sets (EBCDIC, ASCII, FIELDATA, XS-3, and BAUDOT) included as standard.

BASIC FUNCTIONS

Although the monitor can perform numerous diversified operations, its general capabilities can be divided into three basic functions. The first of these is that of displaying data-line activity on the monitor screen (figure 2, left). All displayed data will be in their

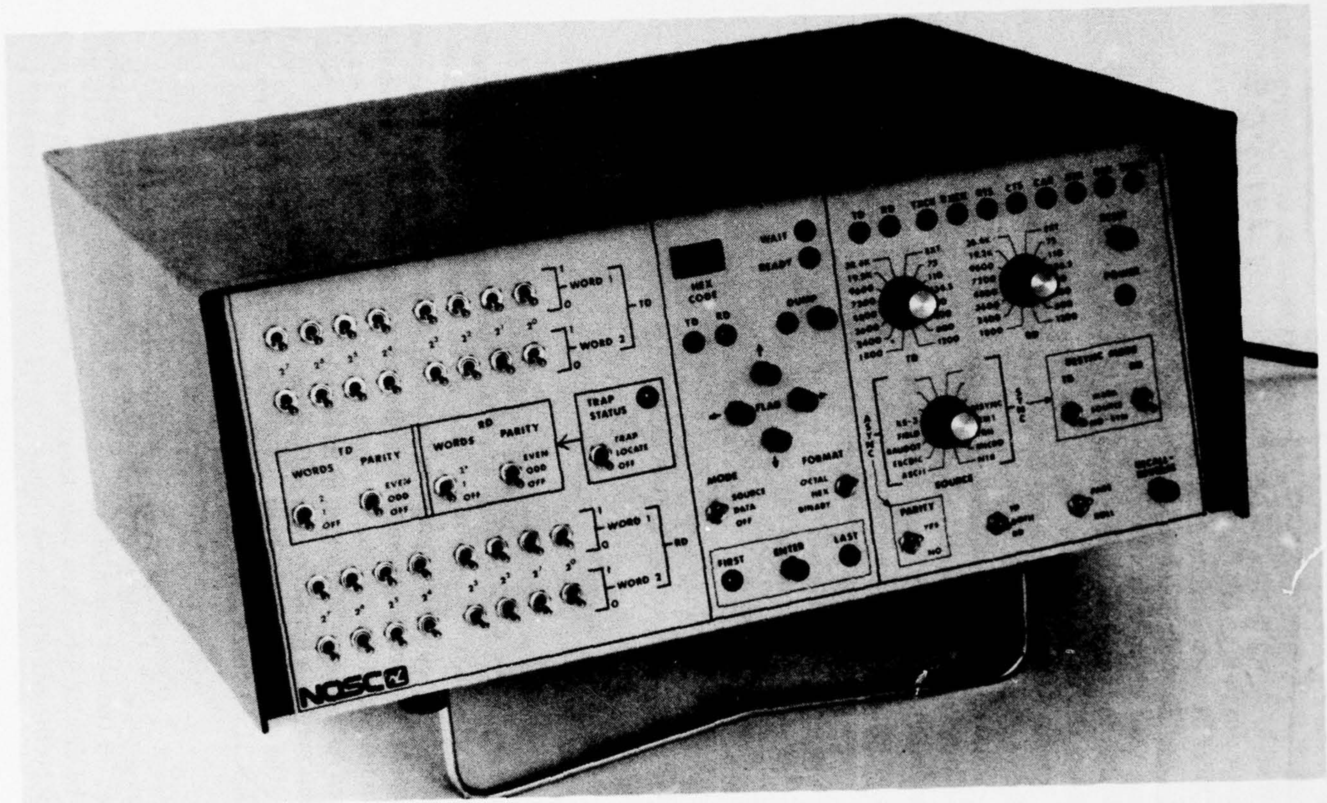

Figure 1. NOSC Model DLM-1 Data-Line Monitor/Analyzer.

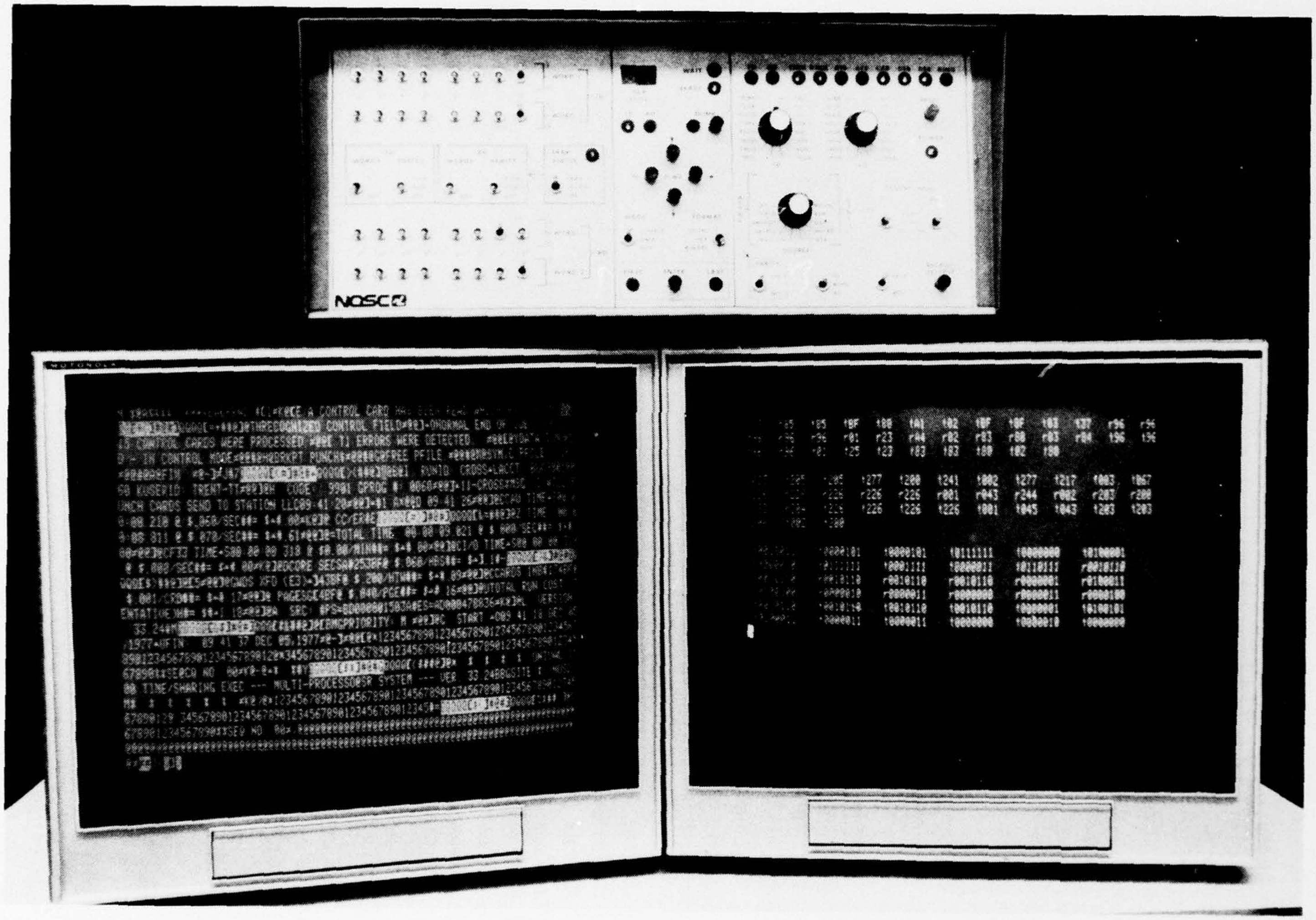

Figure 2. Typical data-line display (left), typical screen dump in hexadecimal, octal, and binary (right) representing a typical installation.

code-equivalent alpha/numeric/symbolic form. Standard control characters are displayed bouncing slightly to differentiate them from normal printable characters. The control function associated with these bouncing characters can be found in the code charts in Appendix A. It should be noted, however, that in those protocols which define control characters strictly by their parity, the control characters do not bounce and must be detected by doing a locate on that specific parity. Transmit Data (TD) appear as light symbols on a dark background and Receive Data (RD) appear as dark symbols on a light background.

The second basic function is that of locating given characters or two-character sequences on the screen and in incoming real-time data flow. The located characters are flagged such that they are easily seen on the screen. This feature also allows the trapping of certain incoming data patterns and locks out any additional incoming data after the trap sequence has completed.

The remaining function is that of dumping any of the data appearing on the screen to an external serial RS-232 device such as a hard-copy terminal for more detailed analysis (figure 2, right). This dump can be done in the binary, octal, or hexadecimal format with a variety of column formats, dump formats, and dump baud rates available. The lower case "r" or "t" preceding each word indicating Receive Data or Transmit Data is a typical switchable option. The numerous other options associated with each of the functions are described in detail in a later section.

The monitor can directly interface with RS-232 asynchronous lines up to 38.4 kilobaud, and to RS-232 synchronous lines up to several hundred kilobaud, the exact maximum synchronous rate being a function of the protocol selected and the signal quality. A minimum loading effect on circuits being monitored is ensured by high-impedance operational-amplifier inputs on all monitor lines.

The unit is also full duplex and hence Transmit and Receive data-line monitoring activities are completely independent of each other. The synchronous monitoring logic is under microprogram control which makes it readily adaptable to a variety of protocols which are not included in the standard model. All of the various screen enhancement features are also under microprocessor control and thus may be altered if a special requirement is encountered.

OPERATIONAL FEATURES

Controls and switches most frequently used are located on the front panel of the data-line monitor (figure 3). Less frequently used controls are located on the back panel (figure 4). Setting of these controls for accomplishing the several functions of which the monitor is capable is discussed in the following paragraphs.

SCREEN REGENERATION

A blanked-out screen may be regenerated by depressing the RECALL-REVERSE pushbutton.

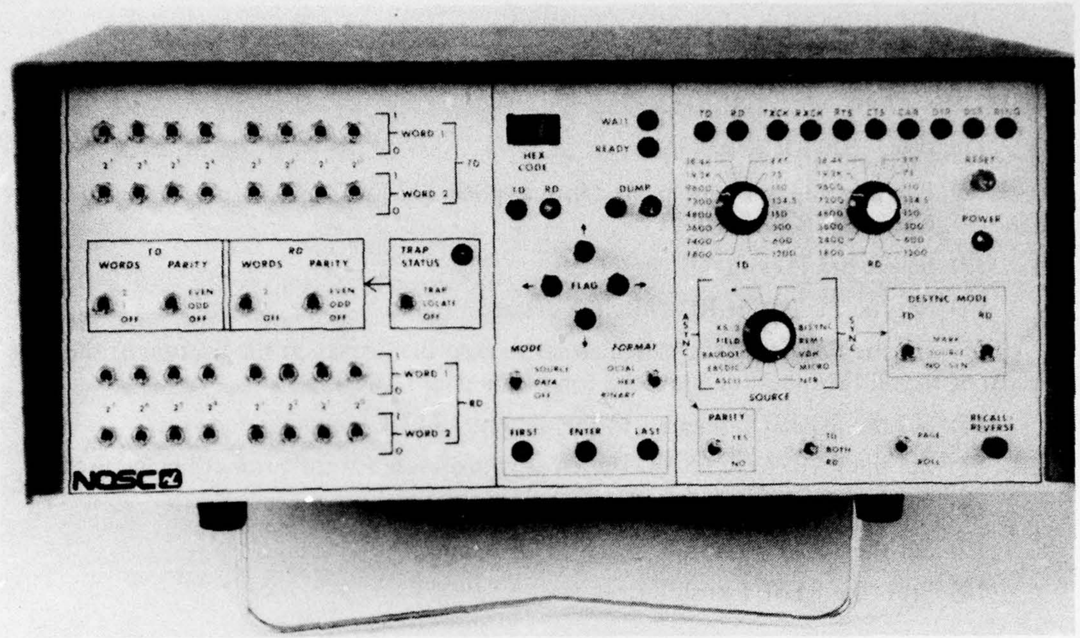

Figure 3. Front-panel controls.

Figure 4. Back-panel controls.

ASYNCHRONOUS LINE MONITORING

Monitoring of asynchronous data lines is accomplished by taking the following actions:

(1) Place POWER switch ON;

(2) Plug the line to be monitored into any RS-232 DATA-IN connector on the back panel;

(3) Select the TD and RD baud rates;

(4) Set the TD-BOTH-RD switch as desired;

(5) Set the PAGE-ROLL switch either to stop the display at the bottom of the page (PAGE) or to roll the oldest data off the top of the page (ROLL);

(6) Set the SOURCE selector to the desired ASYNC character code set;

(7) Set the PARITY YES-NO switch as appropriate for the protocol being used;

(8) Set the MODE switch to OFF;

(9) Set the TRAP STATUS switch to OFF; and

(10) Press the RESET pushbutton.

SYNCHRONOUS LINE MONITORING

Action for monitoring synchronous data lines is accomplished in the following manner:

(1) Place POWER switch ON;

(2) Plug the line to be monitored into any RS-232 DATA IN connector on the back panel;

(3) Set the TD-BOTH-RD switch as desired;

(4) Set the PAGE-ROLL switch either to stop the display at the bottom of the page (PAGE) or to roll the oldest data off the top of the page (ROLL).

(5) Set the SOURCE selector to the desired SYNC protocol;

(6) Set the DESYNC MODE switches to the desired method of exiting the synchronous message (the SOURCE and NO-SYN positions are best for general use) (see the DETAILED CONTROL OPERATION paragraphs for a full explanation of exit methods);

(7) Set the MODE switch to OFF;

(8) Set the TRAP STATUS switch to OFF; and

(9) Press the RESET pushbutton.

DETERMINATION OF HEXADECIMAL CODE

Determination of the hexadecimal code for any screen character is accomplished as follows:

(1) Set the MODE switch to SOURCE or DATA;

(2) Move the cursor over the character in question using the four FLAG pushbuttons; and

(3) Read the hexadecimal code from the HEX CODE window.

DUMPING OF SCREEN DATA CODES TO ANOTHER DEVICE

All dumps are in serial 7-bit ASCII code plus one parity bit (even parity) and two stop bits:

(1) Plug the dump device into one of the back-panel RS-232 DATA OUT connectors (dump data will come from pin 2 of the male and pin 3 of the female connector);

(2) Set the TD baud-rate selector switch to the desired dump baud rate;

(3) Select the maximum number of columns desired in the dump with the back-panel DUMP COLUMN FORMAT selector;

(4) Select the quantity of fill characters to be generated after each carriage return-line feed at the end of each dump line with the back-panel FILL QUANTITY selector;

(5) Select the fill character desired with the back-panel FILL TYPE switch (NULL is the most common but if the TD WORD 1 position is chosen, set up the code for the desired fill character in the TD WORD 1 switch bank on the front panel) (bit 8 is ignored);

(6) Set the FORMAT switch to HEX, OCTAL, or BINARY;

(7) Place the MODE switch to the SOURCE or DATA position (SOURCE will insert a lower-case "t" or "r" in front of each code in the dump indicating either TD or RD while DATA will leave off the letter);

(8) Set the TD-BOTH-RD switch to reflect the screen data to be dumped;

(9) Move the cursor over the first character to be dumped using the four FLAG pushbuttons;

(10) Note that the FIRST lamp is blinking and then press the ENTER pushbutton;

(11) Move the cursor over the last character to be dumped;

(12) Note that the LAST lamp is blinking and then press the ENTER pushbutton;

(13) Note that the READY lamp is blinking;

(14) When ready to dump, press the DUMP pushbutton (the DUMP lamp will blink and the cursor will progress along the dump path indicating that data are being dumped to the external device);

(15) To dump the same portion of the screen again, set the various format parameters as desired and press DUMP again; and note

(16) The FIRST and LAST dump markers cannot be repositioned without first switching the MODE switch through the OFF position.

LOCATION OF A CHARACTER OR A CHARACTER SEQUENCE ON THE SCREEN

The following steps apply equally to TD and RD depending upon which switches are used. TD and RD may be located simultaneously or separately. Three cases will be described and for each the first step is to set the TRAP STATUS switch to LOCATE. For case one, to locate all occurrences of a specific parity:

(1) Set the WORDS switch to OFF;

(2) Set the PARITY switch (left side of front panel) as desired; and

(3) Note that all characters of the selected parity are blinking.

For case two, to locate all occurrences of a specific character:

(1) Set the code, including parity if any, of the desired character into the WORD 1 switch bank (if the code used is less than eight bits, the position of the unused bits' switches is immaterial);

(2) Set the PARITY switch (left side of front panel) to OFF;

(3) Set the WORDS switch to 1; and note

(4) All occurrences of the selected character are blinking.

For case three, to locate all occurrences of a selected two-character sequence:

(1) Place the codes of the two characters, including parity (if any), in the WORD 1 and WORD 2 switch banks (if the code used is less than eight bits, the position of the unused bits' switches is immaterial);

(2) Set the PARITY switch to OFF;

(3) Set the WORDS switch to 2; and note

(4) All occurrences of the selected two-character sequence are blinking.

TRAPPING OF A CHARACTER OR SEQUENCE

In this operation, when a selected character or sequence is detected on the RS-232 data lines, an audible alarm will sound, the selected characters will blink, and approximately one third screen additional data will be allowed to display. All incoming data will be locked out as the blinking TRAP STATUS lamp indicates.

(1) Set the MODE switch to OFF;

(2) Set the TRAP STATUS switch to TRAP;

(3) Perform the steps used to locate a character; and

(4) Clear lockout by switching TRAP STATUS switch to LOCATE or OFF.

DETAILED CONTROL OPERATION, FRONT PANEL

The front panel (figure 3) is divided into three sections with the right section containing controls for the basic monitoring function. The POWER lamp indicates that power is applied to the unit and the RESET pushbutton clears the screen and resets the logic circuitry to a determined initial state.

INTERCHANGE CIRCUIT LAMPS

The top row of ten lamps reflect the condition of the interchange circuits. The OFF state of a lamp implies a circuit MARK (negative) or a circuit open, and the ON state implies a circuit space (positive). Because of the high impedance of the monitor inputs, the lamp for an open circuit may flicker as data are being transferred because of crosstalk from the active circuits. The RS-232 connector pins associated with each lamp are 2 (TD), 3 (RD), 15 (TXCK), 17 (RXCK), 4 (RTS), 5 (CTS), 8 (CAR), 20 (DTR), 6 (DSR) and 22 (RING).

RECALL-REVERSE PUSHBUTTON

If no new data have been displayed on the screen for about nine minutes, the screen will go blank to prevent burning of the phosphor. Pressing the RECALL-REVERSE pushbutton will cause the display to return for another nine minutes. Any new data coming onto the screen when it is dark will also recall the display intact. Holding the button depressed will cause all light-on-dark characters to become dark-on-light and vice-versa.

BAUD RATE SELECTOR SWITCHES

The asynchronous baud rate for incoming data may be selected independently for RD and TD by these two selector switches. A position for input of an external clock is also provided. The external clock frequency must be 16 times the desired baud rate and must be at RS-232 logic levels (–25 volts to –3 volts for LOW and +3 volts to 25 volts for HIGH). The clock is fed to any of the four RS-232 DATA IN, 25-pin connectors on the back panel. Pin 15 is for the TD clock and pin 17 is for the RD clock. The TD baud-rate selector also selects the dump-baud rate.

SOURCE SELECTOR SWITCH

This switch allows the selection of either the synchronous protocol or the desired asynchronous code set. The proper code set is selected automatically in the synchronous mode. There are three unmarked positions of this switch for both asynchronous and synchronous operation which may be programmed as desired in the future should additional protocols or codes be required.

PARITY SWITCH

This switch tells the logic if the synchronous data have a parity bit. If so, the parity bit will be written into the screen memory along with the data bits and will be considered in any locate or trap operation as part of the data word. In the synchronous mode, the proper parity status is automatically determined by the selected protocol.

TD-BOTH-RD SWITCH

This switch determines (1) which data line will be monitored and thus be allowed into the screen memory, (2) which data type will be displayed if TD and RD are both in screen memory, and (3) which data type will be dumped if TD and RD are both in screen memory.

PAGE-ROLL SWITCH

This switch determines if incoming data will continuously write back over the bottom row once the screen has been filled leaving the remainder of the screen intact (PAGE) or will cause the display to roll up thereby destroying the topmost (oldest) line (ROLL).

DESYNC MODE SWITCHES

These switches are used only in the synchronous mode. The monitor displays synchronous data only after it has detected one SYNC character appropriate to the selected protocol. Any data before this point are ignored since it is impossible to know the proper framing point. Once the SYNC character has been detected, the monitor is put in synchronization which ensures proper framing. At this point, data display is enabled. At the completion of a given message, it is necessary to take the monitor out of synchronization so that it will be able to resynchronize on the next message. The DESYNC MODE switches determine how this desynchronization will occur. The procedure varies with different protocols and is independently selectable for TD and RD.

NTR-MARK. The monitor will display all data from and including the first SYNC character (96 hexadecimal) through the first even parity DELETE character (FF hexadecimal). This FF hexadecimal may be caused by the data line going to an idle (MARK) state between messages. The monitor will then return to the look-for-sync mode.

NTR-SOURCE. When this position is selected, all data from and including the first SYNC character (96 hexadecimal) through the first character following the ETX character (03 hexadecimal) will be displayed. The monitor then returns to the look-for-sync mode.

NTR-NO-SYN. Operation in this position is the same as NTR-SOURCE except that the display begins with the first non-SYNC character after the initial SYNC characters. This mode allows the display of message data uncluttered by SYNC characters.

MICRO-(all). In this position, operation is the same as in NTR, the only difference being that the MICRO SYNC character is 16 hexadecimal and the MICRO ETX character is 83 hexadecimal.

VDH-MARK. In this switch position (not recommended), the monitor will display all data from and including the first SYNC character (16 hexadecimal) through the first even parity DELETE character (FF hexadecimal).

VDH-SOURCE. In this position, all data from and including the first SYNC character (16 hexadecimal) through the third character after the ETX character (83 hexadecimal) are displayed provided the message-packet format is correct. (See Report 1822, INTERFACE MESSAGE PROCESSOR, by Bolt, Beranek, and Newman, for proper packet formatting.) If the message packet is in an incorrect format, the character which breaks the correct format will be the last character displayed and the monitor will enter the look-for-sync mode.

VDH-NO-SYN. In this switch position, as in VDH-SOURCE, the display begins with the first non-SYNC character after the initial SYNC characters. This is a preferred mode and since the VDH protocol fills the spaces between the messages with SYNC characters, this is the only practical mode in which to monitor VDH.

REM1-MARK. This position is not recommended. When selected, all characters from and including the first SYNC character (35 hexadecimal) through the first odd-parity right parenthesis (7 hexadecimal) are displayed. The monitor then returns to the look-for-sync mode. It should be noted that since an odd parity right parenthesis is a legitimate character, use of this mode will result in the loss of all message data after this character is received and until the start of the next message.

REM1-SOURCE. In this switch position, all data from and including the first SYNC character (35 hexadecimal) through the first character after the EOM character (55 hexadecimal) are displayed. The monitor then returns to the look-for-sync mode.

REM1-NO-SYN. This mode is essentially the same as REM1-SOURCE except that the display starts with the first non-SYNC character after the initial SYNC characters.

BISYNC-MARK. When this switch position is selected, all data from and including the first SYNC character (32 hexadecimal) through the first PAD character (FF hexadecimal) are printed. The monitor then returns to the look-for-sync mode.

BISYNC-SOURCE. This position results in operation similar to that of BISYNC-MARK except that the PAD character is not displayed.

BISYNC-NO-SYN. In this position, all data from the first non-SYNC character after the initial SYNC characters to, but not including the first PAD character (FF hexadecimal) are displayed. The monitor then returns to the look-for-sync mode.

The middle front panel section controls the manual cursor positioning and the marking and dumping of screen data to an external device.

WAIT LAMP

The WAIT lamp is an indicator which says that no operator action should be undertaken when it is illuminated. There are no WAIT conditions programmed into the standard DLM-1.

MODE SWITCH

Use of this switch gives the operator manual control of the cursor position via the four FLAG pushbuttons and allows the screen to be prepared for dumping. In the SOURCE position, each character code dumped will be preceded by a lower-case "t" or "r" indicating that the code is due to a TD character or an RD character, respectively. In the DATA position, the "t" and "r" are suppressed.

In both the DATA and SOURCE positions, all data on the RS-232 lines are ignored. This data lockout is indicated by the blinking of the TRAP STATUS lamp in the left section of the front panel.

Returning the MODE switch to the OFF position clears any dump flags which have been set, aborts any dump which may be in progress, returns the cursor to monitor control, and allows monitoring of the RS-232 lines to resume.

FLAG PUSHBUTTONS

There are four flag pushbuttons and these allow manual positioning of the cursor when the MODE switch is not in the OFF position. The cursor will be blanked if it is moved into the region between the bottom of the page and the end of the last line displayed. The hexadecimal code for the character over which the cursor resides, including parity if any, will appear in the window labelled HEX CODE. It should be noted that even if the cursor is moved into the blanked region, the HEX code of the character that last occupied the blanked cursor position will be displayed until incoming data are written over it. This could be useful if the screen is inadvertently erased and the data that were displayed are still needed

for examination. In addition, the TD or RD lamp below the HEX CODE window will show the origin of the character. Cursor movements which wrap around the top, bottom, and sides of the screen are allowed and provide a quicker means for reaching various points on the screen.

FIRST LAMP

The FIRST lamp indicates that the flag may be entered, via the ENTER pushbutton, which marks the first character that will be dumped. Entering this flag in the blanked region of the screen can result in an aborted dump and undesired data (see DUMP PUSHBUTTON).

LAST LAMP

The LAST lamp indicates that the flag may be entered, via the ENTER pushbutton, which marks the final character to be dumped. This flag may be entered on top of the FIRST flag in order to dump only one character. *Entering this flag in front of the FIRST flag or in the blanked region of the screen can result in an aborted dump or undesired data (see DUMP pushbutton).* Once the LAST flag has been entered, the flags may not be re-positioned without first going through the MODE-OFF switch position.

READY LAMP

When blinking, this READY lamp indicates that the FIRST and LAST flags have been entered and the screen is ready to be dumped.

DUMP PUSHBUTTON

All dumps are made in seven-bit ASCII code plus a parity bit to form even parity. The dump baud rate is selected by the TD baud-rate selector switch on the right section of the front panel.

The DUMP pushbutton causes the screen to be dumped in the selected format starting with and including the character over which the FIRST flag is positioned and ending with and including the character over which the LAST flag is positioned. This region may be dumped consecutively as many times as desired and in as many formats as desired without re-entering the FIRST and LAST flags.

If a dump of the position which the cursor occupied when the MODE switch was OFF is attempted, the dump will abort when this position is reached. This is a safeguard against accidentally dumping the blanked region of the screen.

If desired, however, any portion of the blanked region may be dumped by placing the FIRST flag anywhere desired after the MODE OFF cursor position and the LAST flag anywhere desired on or after the FIRST flag but before the MODE OFF cursor position. Note that since cursor movements within the blanked region are also blanked, care will have to be taken to keep track of the cursor position.

DUMP LAMP

This indicator blinks when material is in process of being dumped from the screen. The cursor will position itself over the character being dumped and will return to its last pre-dump position when the dump is completed.

FORMAT SWITCH

This control determines whether the dump is in OCTAL, HEXADECIMAL, or BINARY. In codes of less than eight bits, any unused bits are suppressed. This dump may be column formatted and fill formatted by switches on the back panel.

The left front panel section controls the location of characters on the screen and the trapping of characters entering the monitor on the RS-232 data lines.

TRAP-STATUS SWITCH

In the LOCATE position, this switch allows the TD and RD WORDS and PARITY switches to select the character formats which will be blinked on the screen. All occurrences will be blinked.

In the TRAP position, the same function is performed as in the LOCATE position and, in addition, whenever the selected format is encountered on the real-time RS-232 data line, an audible alarm sounds and approximately one third more page of input is allowed to enter the monitor. At this time, the TRAP-STATUS lamp will begin to blink indicating that real-time data have been locked out. Moving the TRAP-STATUS switch from the TRAP position clears the lockout condition.

TRAP-STATUS LAMP

When blinking, this lamp indicates that all real-time RS-232 data have been locked out.

PARITY SWITCH, TD AND RD

This switch, in conjunction with the TRAP-STATUS switch, locates or traps all occurrences of even or odd parity.

WORDS SWITCH, TD AND RD

This switch also works in conjunction with the TRAP-STATUS switch. In the 1 position, all occurrences of the character set up in the WORD 1 switch bank are blinked or trapped and blinked. In the 2 position, all occurrences of the two-character sequence set up in the WORD 1 and WORD 2 switch banks are blinked or trapped and blinked. Since the DLM-1 is full duplex, the two characters of a sequence are detected even if interleaved by any number of characters from the opposite data line; in other words, TD and RD intermixed.

WORD 1 AND 2 SWITCH BANKS

These switch banks are used to set up the code of the word or words that are to be trapped or located on the screen. If the code set contains less than eight bits, the setting of the switches for the unused bits is immaterial. The parity bit must be considered in protocols using parity. The TD WORD 1 switch bank is also used to set up the fill character to be sent after a carriage return and line feed during a dump if so selected (see FILL-TYPE switch in the discussion of back-panel controls).

DETAILED CONTROL OPERATION, BACK PANEL

The back panel (figure 4) of the monitor provides the means for interconnecting the device with lines to be monitored, for connecting the monitor to a device which will receive a dump, and contains switches for turning power on and off, for selecting column formats, and for selecting a character which will be used as a fill.

RS-232 DATA-IN CONNECTORS

There are four data-in connectors and each has 25 pins. All pins in one connector are connected in parallel with those in the other three. The line to be monitored may be plugged into any one of the four connectors and, because all pins are in parallel, the monitor may be put into the actual data line by entering it on one connector and leaving from another.

RS-232 DATA-OUT CONNECTORS

There are two data-out connectors and each has 25 pins. The dump device is connected to these connectors. One connector is set up to dump to a modem configuration (pin 2 (male) active) and the other is set up to dump to a terminal configuration (pin 3 (female) active). All necessary handshaking signals are present at these two connectors.

FILL-TYPE SWITCH

This is a three-position switch used to select the character which will be used as a fill. The most common character is the NULL (00 hexadecimal). The delete character (FF hexadecimal) is also available along with any character selected in the TD WORD 1 switch bank on the front panel. Bit 8 of the bank is ignored.

FILL-QUANTITY SELECTOR SWITCH

Since the several types of devices which can receive a screen dump may require differing amounts of delay after receiving a carriage return-line feed before they can accept additional printable data, the number of fill characters which are to follow the line feed may be selected with this switch.

COLUMN-FORMAT SELECTOR SWITCH

This switch determines the number of columns in the dump and this number minus one is the maximum number of columns into which dump data will be written before a carriage-return, line-feed, fill sequence is generated. This switch should be set normally to the maximum column capability of the device which will receive the dump. If this switch is set to the infinity position, no carriage-return nor line-feed, fill sequence will be generated and the entire dump will consist of one continuous string of data.

POWER SWITCH AND FUSE

The POWER switch controls the alternating-current input to the monitor and the accessory receptacle. The fuse is used to protect the monitor circuitry in case of a power malfunction. The accessory receptacle is not fused.

An external view of the monitor is shown in figure 5.

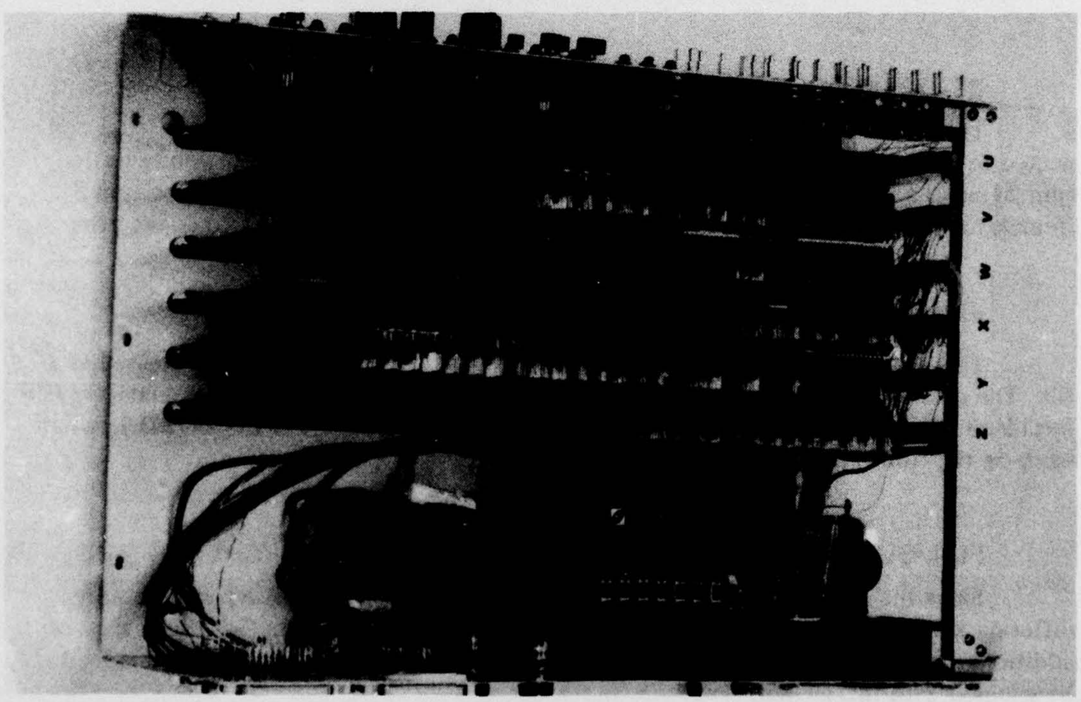

Figure 5. Internal top view of DLM-1 Data-Line Monitor/Analyzer.

APPENDIX A: CHARACTER CODE SET TABLES

The following tables give both the hexadecimal and the octal codes for character sets monitored by the standard model DLM-1. Since control functions are displayed as a bouncing character, that character is shown below the function it represents in the tables.

Those codes for which no character exists are left blank and the occurrence of such a code will be displayed as an upside down question mark.

TABLE A1. ASCII CHARACTER SET, HEXADECIMAL.

MSD

LSD

HEX	Ø	1	2	3	4	5	6	7
Ø	NUL @	DLE P	SPC	Ø	@	P	`	p
1	SOH A	DC1 Q	!	1	A	Q	a	q
2	STX B	DC2 R	"	2	B	R	b	r
3	ETX C	DC3 S	#	3	C	S	c	s
4	EOT D	DC4 T	$	4	D	T	d	t
5	ENQ E	NAK U	%	5	E	U	e	u
6	ACK F	SYN V	&	6	F	V	f	v
7	BEL G	ETB W	'	7	G	W	g	w
8	BS H	CAN X	(	8	H	X	h	x
9	HT I	EM Y	)	9	I	Y	i	y
A	LF J	SUB Z	*	:	J	Z	j	z
B	VT K	ESC [	+	;	K	[	k	{
C	FF L	FS \	,	<	L	\	l	¦
D	CR M	GS]	-	=	M	]	m	}
E	SO N	RS ^	.	>	N	^	n	~
F	SI O	US _	/	?	O	_	o	del

TABLE A2. ASCII CHARACTER SET, OCTAL.

MSD

LSD OCT	ØØ	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	1Ø	11	12	13	14	15	16	17
Ø	NUL @	BS H	DLE P	CAN X	SPC	(	Ø	8	@	H	P	X	`	h	p	x
1	SOH A	HT I	DC1 Q	EM Y	!	)	1	9	A	I	Q	Y	a	i	q	y
2	STX B	LF J	DC2 R	SUB Z	"	*	2	:	B	J	R	Z	b	j	r	z
3	ETX C	VT K	DC3 S	ESC [	#	+	3	;	C	K	S	[	c	k	s	{
4	EOT D	FF L	DC4 T	FS \	$	,	4	<	D	L	T	\	d	l	t	¦
5	ENQ E	CR M	NAK U	GS }	%	-	5	=	E	M	U	]	e	m	u	}
6	ACK F	SO N	SYN V	RS ^	&	.	6	>	F	N	V	^	f	n	v	~
7	BEL G	SI O	ETB W	US _	'	/	7	?	G	O	W	_	g	o	w	del

TABLE A3. EBCDIC CHARACTER SET, HEXADECIMAL.

MSD

LSD

HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL @	DLE P	DS m		SPC	&	-	‡					{	}	\	0
1	SOH A	DC1 Q	SOS n				/		a	j	~		A	J		1
2	STX B	DC2 R	FS \	SYN V					b	k	s		B	K	S	2
3	ETX C	DC3 S							c	l	t		C	L	T	3
4	PF a	RES e	BYP o	PN q					d	m	u		D	M	U	4
5	HT I	NL f	LF J	RS ^					e	n	v		E	N	V	5
6	LC b	BS H	EOB ETB W	UC r					f	o	w		F	O	W	6
7	del	IL g	PRE ESC [	EOT D					g	p	x		G	P	X	7
8		CAN X							h	q	y		H	Q	Y	8
9	RLF c	EM Y						`	i	r	z		I	R	Z	9
A	SMM d	CC h	SM p		¢	!	¦	:								
B	VT K				.	$	,	#								
C	FF L	IFS i		DC4 T	<	*	%	@								
D	CR M	IGS j	ENQ E	NAK U	(	)	_	'								
E	SO N	IRS k	ACK F		+	;	>	=								
F	SI O	IUS l	BEL G	SUB Z	|	¬	?	"								⇕ pad

TABLE A4. EBCDIC CHARACTER SET, OCTAL.

MSD

LSD

OCT	Ø Ø	Ø 1	Ø 2	Ø 3	Ø 4	Ø 5	Ø 6	Ø 7	1 Ø	1 1	1 2	1 3	1 4	1 5	1 6	1 7
Ø	NUL @		DLE P	CAN X	DS m				SPC		&		-		‡	
1	SOH A	RLF c	DC1 Q	EM Y	SOS n								/			`
2	STX B	SMM d	DC2 R	CC h	FS \	SM p	SYN V			¢		!		¦		:
3	ETX C	VT K	DC3 S							.		$		,		#
4	PF a	FF L	RES e	IFS i	BYP o		PN q	DC4 T		<		*		%		@
5	HT I	CR M	NL f	IGS j	LF J	ENQ E	RS ^	NAK U		(		)		_		'
6	LC b	SO N	BS H	IRS k	EOB ETB W	ACK F	UC r			+		;		>		=
7	▒ del	SI O	IL g	IUS l	PRE ESC [	BEL G	EOT D	SUB Z		|		¬		?		"

LSD

OCT	2 Ø	2 1	2 2	2 3	2 4	2 5	2 6	2 7	3 Ø	3 1	3 2	3 3	3 4	3 5	3 6	3 7
Ø		h		q		y			{	H	}	Q	\	Y	Ø	8
1	a	i	j	r	~	z			A	I	J	R		Z	1	9
2	b		k		s				B		K		S		2	
3	c		l		t				C		L		T		3	
4	d		m		u				D		M		U		4	
5	e		n		v				E		N		V		5	
6	f		o		w				F		O		W		6	
7	g		p		x				G		P		X		7	⇕ pad

TABLE A5. XS-3 CHARACTER SET, HEXADECIMAL.

MSD

LSD

HEX	Ø	1	2	3
Ø	SPC	&	´	≠
1	]	:	*	%
2	-	.	$	,
3	Ø	?	!	+
4	1	A	J	/
5	2	B	K	S
6	3	C	L	T
7	4	D	M	U
8	5	E	N	V
9	6	F	O	W
A	7	G	P	X
B	8	H	Q	Y
C	9	I	R	Z
D	\	#	(	⌑
E	;	<	@	>
F	[	=	△	)

TABLE A6. XS-3 CHARACTER SET, OCTAL.

MSD (columns), LSD (rows)

OCT	Ø	1	2	3	4	5	6	7
Ø	SPC	5	&	E	´	N	≠	V
1	]	6	:	F	*	O	%	W
2	–	7	.	G	$	P	,	X
3	Ø	8	?	H	!	Q	+	Y
4	1	9	A	I	J	R	/	Z
5	2	\	B	#	K	(	S	⌑
6	3	;	C	<	L	@	T	>
7	4	[	D	=	M	△	U	)

TABLE A7. FIELDATA CHARACTER SET, HEXADECIMAL.

		MSD			
	HEX	Ø	1	2	3
	Ø	@	K	)	Ø
	1	[	L	-	1
	2	]	M	+	2
	3	#	N	<	3
	4	△	O	=	4
	5	SPC	P	>	5
	6	A	Q	&	6
LSD	7	B	R	$	7
	8	C	S	*	8
	9	D	T	(	9
	A	E	U	%	'
	B	F	V	:	;
	C	G	W	?	/
	D	H	X	!	.
	E	I	Y	,	¤
	F	J	Z	\	≠

TABLE A8. FIELDATA CHARACTER SET, OCTAL.

MSD

LSD	OCT	Ø	1	2	3	4	5	6	7
	Ø	@	C	K	S	)	*	Ø	8
	1	[	D	L	T	-	(	1	9
	2	#	E	M	U	+	%	2	'
	3	△	F	N	V	<	:	3	;
	4	SPC	G	O	W	=	?	4	/
	5	A	H	P	X	>	!	5	.
	6	B	I	Q	Y	&	,	6	¤
	7	C	J	R	Z	$	\	7	≠

TABLE A9. BAUDOT CHARACTER SET, HEXADECIMAL.

MSD

		LOWER		UPPER	
	HEX	Ø	1	2	3
LSD	Ø		E		3
	1	T	Z	5	"
	2	CR M	D	CR M	$
	3	O	B	9	?
	4	SPC	S	SPC	BEL G
	5	H	Y	#	6
	6	N	F	,	!
	7	M	X	.	/
	8	LF J	A	LF J	-
	9	L	W	)	2
	A	R	J	4	'
	B	G	↑ upr	&	↑ upr
	C	I	U	8	7
	D	P	Q	Ø	1
	E	C	K	:	(
	F	V	↓ lwr	;	↓ lwr

TABLE A10. BAUDOT CHARACTER SET, OCTAL.

MSD

LSD

	-----LOWER-----				-----UPPER-----			
OCT	Ø	1	2	3	4	5	6	7
Ø		LF J	E	A		LF J	3	-
1	T	L	Z	W	5	)	"	2
2	CR M	R	D	J	CR M	4	$	'
3	O	G	B	↑ upr	9	&	?	↑ upr
4	SPC	I	S	U	SPC	8	BEL G	7
5	H	P	Y	Q	#	Ø	6	1
6	N	C	F	K	,	:	!	(
7	M	V	X	↓ lwr	.	;	/	↓ lwr